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EDITORIAL NOTES

EXPLANATION

OBSERVATION and experience tend to a growing belief in our mind that, due to "enemy action," several people in this country are suffering minor inconveniences. For some (we know this means a wide circle) a major inconvenience consequent upon the war is the receipt of the "JOURNAL" on an unusual date, and perhaps delay in our response to correspondence. For this we offer apology; but we would like to explain that it is not *entirely* our fault—that, in fact, we are endeavouring to render, in circumstances occasionally strained, the customary "JOURNAL" service.

GAS AND GLASS

WE publish to-day a valuable Paper given by Mr. R. L. Greaves, Engineer and Manager to the St. Helens Gas Department, to the Manchester District Association of Gas Engineers last week. It concerns the use of gas in the glass industry. The Paper represents knowledge acquired during three years study and practical contact with the glass industry, and comparatively little information has been available on this particular and singularly promising field for the utilization of town gas.

Mr. Greaves laid emphasis upon the assistance of the Industrial Gas Centres in developing the industrial gas load in general. We, too, have for long laid stress on the important point of personal contact between the manager of the gas undertaking and the managers and production managers of the industrial concerns. Gas and industrial gas engineers very soon become *persona grata* in industrial works, and while often they have much to learn, on the other hand gas engineers can with their specialized experience make useful suggestions. This personal contact is a direct means of securing loads for gas, and while, as Mr. Greaves pointed out, it may be that months of work passes without apparent result, unexpectedly the prize is achieved and the work rewarded.

The Paper is bound to save a great deal of initial work and search on the subject treated. It is true that, while the use of town and coke oven gas has been bringing in a new era in the steel and pottery industries, and the progress has been reported, important growth in the use of town gas has been achieved also in the glass industry, but not so widely reported. Hence the Paper must be of value in adding to the record of specialized industrial use of gas.

ATMOSPHERIC POLLUTION

WE referred last week to the publication by the Department of Scientific and Industrial Research of the Report on Atmospheric Pollution for the year ended March 31, 1939. We mention that, despite the increasing industrial activity in the years preceding the outbreak of the war, the state of the atmosphere has shown a steady improvement since 1936. The local authorities making the measurements of atmospheric pollution on which the reports are based have decided to carry on with the investigation if possible, since a knowledge of the state of the atmosphere is of importance even in wartime. The seasonal variation of pollution from domestic and office fires is clearly shown by the figures given, while the effect of the pollution in cutting off daylight from the centres of towns is brought out in diagrams. The report also contains an article on the effect which atmospheric impurities have upon building stones.

The article is by Mr. R. J. Schaffer, of the Building Research Station, and he shares our oft-repeated contention that until pollution of the atmosphere by smoke and acid gases is regarded in the same light as pollution of water supplies and treated accordingly, disfiguration and decay of building stones due to this cause will necessarily continue. Meanwhile it is desirable to take such steps as may be practicable to minimize its ill effects. There is no absolute remedy, admittedly. Suitable choice and use of materials is the first safeguard against decay, but is of little avail against discoloration by soot. Those building stones that suffer most seriously in this respect are among the most durable. The Author has arrived at the conclusion that surface treatments designed to confer weather resistance are seldom helpful. In special circumstances, where the treated stone can be kept under observation, and where the treatment can be renewed from time to time as may be necessary, a suitably selected stone preservative can occasionally find useful application. General and indis-

We have now moved our central organization to our country offices, and we shall be grateful if all whom it may concern will kindly treat it as a matter of urgency to note the change of address in their records. We shall endeavour to maintain a skeleton staff at 11, Bolt Court. Delays will be obviated if all communications are from now on addressed to :—

51, HIGH STREET, ESHER, SURREY (Telephone : Esher 1142)

criminate use is not to be recommended. Oil paint, applied when the stone is dry and renewed every few years, has good protective qualities. If renewal is neglected the results may be worse than useless.

It must not be overlooked that there are various causes of stone decay, but atmospheric pollution is undoubtedly an important factor. Its effects must in the long run represent a considerable charge on the resources of those responsible for maintenance. Purification of the air—one of the aims of the Gas Industry—would contribute to improve the appearance of buildings and to extend the useful life of the materials employed in their construction.

Turning to the report in general, compared with the previous year there has, we learn, been a definite increase in tar deposited, and of the twelve years shown there are only three with a higher percentage of the general-average deposit. This can hardly be regarded as encouraging. It is, in fact, somewhat remarkable to see that the five years 1928-33 had a consistently low tar deposit when compared with the general average. Then it increased suddenly, remaining fairly high, with the exception of last year. In regard to carbonaceous matter other than tar, this shows an improvement. The figure is the second lowest percentage of the general average of any year during the last twelve, suggesting that the amount of soot emitted into the air is reduced. Again, there is a marked improvement in insoluble ash, since the figure of 81% of the general average is the lowest for the last twelve years. Not only is it the lowest, but the improvement, compared with the previous year, is more marked than in any other year, the deposit of ash having dropped 15%, whereas the biggest previous drop between any two consecutive years was 12% between 1935-36 and 1936-37.

Taking "total solids" as a summary of all the components, we find that there was a deposit of 84% of the general average during the year under review—an improvement of 3% over the previous year and of 33% over 1927-28. It is satisfactory to record that the year to March 31, 1939, showed the lowest percentage of any year since 1927-28.

WINDOWS IN WARTIME

WARTIME problems arising from the widespread use of glass in buildings are principally the obscuration of all artificial lighting at night-time, the protection of windows against fracture due to blast, and the prevention of personal injury resulting from flying pieces of glass when windows are broken either by blast or splinters; to some extent these are interconnected. The attention of physicists has lately been directed to these problems, for they involve the behaviour of materials and other branches of physics such as light, heat, and sound. Among the investigations which have been carried out are those of the Research Department of Messrs. Pilkington Brothers, Ltd., under the direction of Dr. H. Moore. For some time now this firm has been conducting an experimental investigation towards the solution of these problems. A brief account of this work, and the conclusions deduced from it, has appeared in the October issue of the *Journal of Scientific Instruments*.

Among the "black-out" difficulties discussed by Dr. Moore in his article is the cracking of glass which has been painted black, due to greatly increased absorption of radiation and consequent development of temperature differences in the sheet sufficient to cause strains beyond the elastic limit. The tests on methods of preventing the fracture of glass due to blast have been fairly exhaustive, and all confirm that it is virtually impossible to safeguard glass except by completely enclosing it. The article shows that only massive forms of reinforcing systems, such as protective grilles, can be of any value in reducing risk of fracture of the glass itself. It has been found that windows usually burst outwards, due to the suction wave, but there is a risk of splinters breaking through the window, and occasional inward bursts have been observed. Dr. Moore discusses the many different treatments that have been suggested to prevent fragments of glass from flying, such as the fixing of fabric netting and other substances to the glass by various adhesives and by freely hanging screens covering the window on the inside. The article includes interesting photographs showing the type of fracture which occurs to windows treated in various ways. The conclusions arrived at should, we suggest, be studied by gas undertakings. We do not know the acreage of glass of various types in gas showroom premises throughout the country, but it must be considerable.

Personal

At a meeting of the Board of the Sheffield and District Gas Company last week, Mr. RALPH HALKETT, the Company's General Manager and Secretary, was given a seat on the Board, with the Designation of Director and General Manager. His son, Mr. RALPH HALKETT, junr., who has held the appointment of Assistant General Manager for some years, has been given the additional appointment of Secretary, his designation now being Secretary and Assistant General Manager. Mr. Ralph Halkett's appointment as a Director fills the vacancy caused by the death of Sir Robert Hadfield, Bart.

Mr. Halkett became General Manager and Secretary of the Company 21 years ago last April, and the part he has played in its development and that of the South Yorkshire Gas Grid is too well known in the Industry to require emphasizing here. It can well be imagined that what was an outstanding peacetime success has become a productive asset of vital importance in the nation's war effort. Mr. Halkett, junr., after a period with the Bournemouth Gas Company, was appointed assistant to his father at Sheffield in 1929, and became Assistant General Manager three or four years later. He has frequently been called upon to take charge of the huge undertaking which has been built up under his father's management

* * *

Dr. M. BARASH and Mr. C. J. GREENFIELD have now been appointed by the Mines Department as full time Technical Advisors to the Department's Committee on Benzole Recovery. Dr. Barash (who has been released by Messrs. West's Gas Improvement Company for the duration of the war) and Mr. Greenfield are already at work advising gas engineers and the managers of coke ovens as to the best methods to be adopted for improving yields of crude benzole at plants already in existence and in examining the possibilities of installing plants on works not already recovering. The appointment of these technicians should be of great assistance to the Committee in obtaining the desired objects—namely, the increase of the production of benzole accompanied by a wider geographical distribution. Managers of any undertakings wishing to consult these technical officers on any question regarding benzole recovery, or the possibility of installing a plant, are requested to get into touch with Mr. J. A. Beckett, Secretary, Advisory Committee on Benzole Recovery, Mines Department, Dean Stanley Street, S.W.1.

* * *

Mr. WILLIAM DAVIDSON, Ph.D., of Radiation, Ltd., was married on Oct. 12 in Solihull Parish Church, Solihull, to Margot, only daughter of Mr. and Mrs. A. E. Phillips, of Wood Lawn, Solihull. To mark the event, his colleagues have presented him with a canteen of cutlery. Mr. W. R. Drummond, Scottish Secretary of the National Gas Council, was best man.

* * *

We regret that in our Personal note on Oct. 9 relating to the appointment of Mr. C. F. Windrow as Secretary of John Wright & Co., Ltd., we mis-spelt the name of his predecessor, Mr. D. A. JAPES.

Obituary

It is with regret that we announce the death of Mr. H. D. Sharpe, of Radiation, Ltd., as a result of enemy action, on Oct. 9. Mr. and Mrs. Sharpe, their son and daughter, and two neighbours, were killed in their shelter, which received a direct hit by a bomb. Mr. Sharpe originally joined Richmonds Gas Stove Company, Ltd., and was later transferred to the Advertising Staff of Radiation, Ltd. The sympathy of all his friends will be extended to his mother and to his brother, Mr. C. P. Sharpe.

Forthcoming Engagement

Oct.

26.—Manchester and District Junior Association.—Meeting.

Negotiations are in Progress between Loughborough (Leics.) Gas and Electricity Departments and other works in the town with a view to formulating a scheme for repairing the works in case of damage done by enemy air attack.

Grantham Town Council have already obtained the necessary fittings and have converted a number of street lamps so that they can be lit during the blackout, and they have decided to consider the lighting of further lamps at a subsequent meeting.

Wigston (Leics.) Urban Council have decided to install a modified system of street lighting for the winter months in the principal streets. The fittings are on order, and work is to commence as soon as possible, and it has been decided that the cost of the fittings shall be a direct charge on revenue.

A Gas-Filling Station for motor vehicles has been established by the Portmadoc Gas Department. Mr. Blythe, the Gas Engineer, who has fitted a 10 h.p. van belonging to his Department with a "balloon" container, has explained that one filling at a cost of 1s. gives an average mileage with this type of car of seventeen on town work.

The Session of the Yorkshire Junior Gas Association will not be held at the usual time—*i.e.*, October to May, owing to the present situation. The Council, realizing that the activities of the Association should be kept alive if possible, propose meeting again in January next with a view to holding a Session commencing in February and extending to July.

Over 1,000 Visitors a Day attended a Wartime Food and Cookery Exhibition in Manchester organized by the local Food Campaign Committee and actively supported by the Manchester Gas Department. The exhibition ran for 10 days. There were daily demonstrations in the Gas Department's showrooms in the Town Hall, film displays, and lunch hour, afternoon, and evening lectures by eminent lecturers, including Mr. T. Bowen Partington, who is well known in the Gas Industry.

The **Next General Meeting** of the Manchester and District Junior Gas Association will be held on Saturday, Oct. 26, at 2 p.m., at the Engineers' Club, Albert Square, Manchester, when the following short Papers will be read: "Notes on a Concentrated Ammonia Plant," by Mr. A. Blinkhorn (Bolton); and "The Conversion of a High-Pressure Steam Boiler from Oil to Gas Firing," by Mr. E. Bates (Manchester). It has been decided that no meetings shall be held during November and December. The next meeting has been provisionally arranged for Saturday, Jan. 25, 1941, when Mr. J. B. Walsh (Stockport) will read a Paper on "The Co-ordination of High and Low Pressure Gas Supplies."

Mr. William Masterton, Chemist with the Edinburgh Corporation Gas Department, has prepared a device for saving paper charts. Many of the charts used on recorders in the works are not required as permanent records. A 24-hour old record is all that is necessary in most cases. By fitting a transparent celluloid covering with a matt surface over the printed chart and allowing the pen to mark on this, a record is obtained which can be wiped off daily by means of a rag soaked in benzole. Even for charts which require to go to the office daily, to be averaged or integrated, this method is suitable—a spare celluloid disc being put on the instrument while the other is sent to the office. Each disc then does duty for alternate days.

At a Town in the North of England one night last week bombs were dropped in a shopping area, very severely damaging a number of shops, particularly a hairdressers. Directly after the raid, the District Superintendent of the Gas Company was quickly on the spot with fitters, but there were no leaks. Some 20 ft. from where the bomb fell there was a gas water heater. Its front shell was blown off, but a test soon showed that the heater still worked perfectly, although it had been blown off the wall and flung several feet. The explanation was that the "Ascot" had been fixed with lead pipes, and the flexibility of lead had been sufficient to stand the tremendous stresses imposed on the pipes. By 10 o'clock next morning, the heater had been refixed to the wall, the front shell, completely undamaged, replaced, and hot water was being delivered from it just as if nothing had happened.

Enthusiasm and Marked Proficiency are the hall-marks of the Cambridge University and Town Gas Light Company's Division of the St. John Ambulance Association, which continues to gain strength and perform an excellent work. According to the Company's *Gas Bulletin*, the "first aiders" have successfully treated a large number of minor injuries, the majority being at the gas-works thus yielding valuable service to their colleagues in time of need. The old laboratories have been equipped as a temporary ambulance room, where the practices are fully supported. Members also collaborate with the Borough Division for practice weekly. A rota has been arranged whereby members sleep at the gas-works each night so that they are on the spot should their services be needed. In addition they have undertaken the public duty of supplying one member, twice weekly, for attendance at the Regal Cinema. During June ten members passed the re-examination, for which vouchers have been awarded.

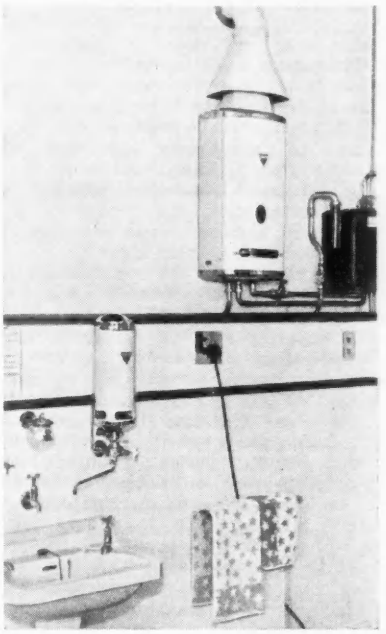
Stockport Long Service Recognised

A total of one hundred and sixty-eight years service with the Stockport Corporation Gas Department was officially recognized on Oct. 16, when, at a meeting of the Gas Committee, the Chairman, Alderman J. T. Lord, presented illuminated certificates for long service to five employees who have retired on superannuation.

There should actually have been six presentations, but Mr. William Kenworthy, a meter inspector, with thirty-five years service to his credit, died the previous evening, and his certificate has been handed over to his widow.

The presentations were made to: Mr. Wm. Johnson, chief meter inspector, with 43 years service; Mr. James Thomas Siddall, boiler foreman, 25 years service; Mr. William Henry Smith, stoker, 23 years service; Mr. Thomas Wilding, retort-house fitter, 21 years service; and Mr. John Trotter, tinsmith, also with 21 years service.

Gas at Good Housekeeping Institute



In the recently opened new quarters of the Good Housekeeping Institute at 30, Grosvenor Gardens, S.W.1, instantaneous gas water heating is represented by "Ascot" sink and multi-point appliances respectively, as shown in this illustration. They should help gas to give a good account of itself in the rigorous hot water tests continually applied at the Institute

British Standard Specifications

Copies of the following recently published British Standard Specifications (A.R.P. Series) may be obtained, at the stated prices, on application to the Secretary of The Institution of Gas Engineers, 1, Grosvenor Place, S.W.1:

BS/ARP 30.—Gauges for Checking Low Values of Illumination. (0.001 to 0.2 Foot-Candle.) (Superseding BS/ARP 30, January, 1940.) Price 2d.

BS/ARP 47.—Testing Incombustible Material to Provide a Minimum Standard of Protection Against Incendiary Bombs. Price 2d.

BS/ARP 48.—Fabric-Bitumen Emulsion Treatment for Roof Glazing. Price 6d.

CF (ARP) 6846.—Corrigendum slip to BS/ARP 48. No charge.

Institution of Gas Engineers

A Meeting of the Council of The Institution of Gas Engineers, for the transaction of urgent business, was held at the Council House, Nottingham, the home town of the President (Mr. George Dixon), on Tuesday, Oct. 8. The members of the Council were welcomed by the Lord Mayor of Nottingham (Councillor Wallis Binch, J.P.).

The meeting was preceded by an informal Luncheon in the Council House, by invitation of the Chairman of the Gas Committee (Sir Albert Ball, Kt., J..P.), who presided, at which several of the civic authorities, including the Lord Mayor, the Sheriff (Mr. Alderman E. A. Braddock, J.P.), and the Town Clerk (Mr. J. E. Richards) were also present.

TOWN GAS IN THE MANUFACTURE AND HEAT TREATMENT OF GLASS

Read at a Meeting of the Manchester District Association of Gas Engineers on October 18, 1940

By

R. L. GREAVES, M.Inst.Gas E.

Engineer and Manager, St. Helens Gas Department

Introduction

IN presenting this subject one does not feel under the common disadvantage of not having anything novel to say, but would rather make the point that there is lack of information regarding the subject, though realizing a difficulty in that it is not necessarily wise to write all that may be desired. In the first place, we have the war, and in the second place the various processes in glass works are to a great extent confidential. Readers will understand how much these two factors can operate as a brake upon the information given.

At the same time, the amount of work which has been necessary in preparing the Paper indicates that it may be of value, particularly to those who come into contact with the glass and allied industries, and to industrial and gas engineers who are developing industrial loads. The Paper represents knowledge acquired during three years study and practical contact with the glass industry, and while the knowledge gained during that period is strictly limited on one hand it is reasonably wide on the other.

Most gas engineers have great faith in the recent movement in the Gas Industry in developing Industrial Gas Centres and particularly in the movement for the appointment of industrial gas engineers in the larger works. Added to this there is the important point of personal contact between the manager of the gas undertaking and the managers and production managers of the industrial concerns. Gas and industrial gas engineers very soon become *persona grata* in industrial works, and while often they have much to learn (the specialists know more about the subject often than the gas engineers), on other occasions the gas engineers can with their specialized experience make very useful suggestions. While many important new loads would obviously be obtained by the Gas Industry in any case, unquestionably this personal contact is a direct means of securing other loads. It may be that months of work passes without apparent result and then unexpectedly the prize is achieved and the work rewarded.

If, therefore, any reader of this Paper finds himself in the position in which the writer was three years ago—of desiring to obtain knowledge about the glass industry and to find written references on the use of town gas in that industry—by referring to this Paper it is hoped that a great deal of initial work and search may be saved. The writer at least has not found any more helpful bibliography than the list herewith and knows that anyone following that bibliography would at least gain a grasp of the fundamentals underlying the subject. If any other useful references have been missed (as is more than likely) readers might add them to this list and the writer would be very much obliged to be notified of any such references.

Books in the English language on the general aspects of glass technology are few. References in the British Gas Press to the use of gas in the glass industry are also few.

Perhaps few gas engineers, therefore, have perused the standard works of reference of the glass industry. This is regrettable because owing to the enormous heat requirements of that industry, the specialized knowledge and experience of heat application and utilization of refractories gained in glass works, amply repays study, and covers the use of coal, producer gas, coke oven gas, town gas, oil, and electricity.

Growth in the Use of Gas in the Glass Industry

While the use of town and coke oven gas has been bringing in a new era in the steel and pottery industries, and the progress has been reported in the Gas Press, important growth in the use of Town Gas has been achieved also in the glass industry, but not so widely reported. Hence this paper should be of value in adding to the record of specialized industrial use of gas. The author is only in a position to speak of the growth in St. Helens but understands that success has been achieved in other glass making areas. Centred in an area which looks upon the glass industry as peculiarly its own and where coal is available locally—in one instance the glass manufacturers are the owners of a colliery—the problem identically with that in similar circumstances in the potteries,

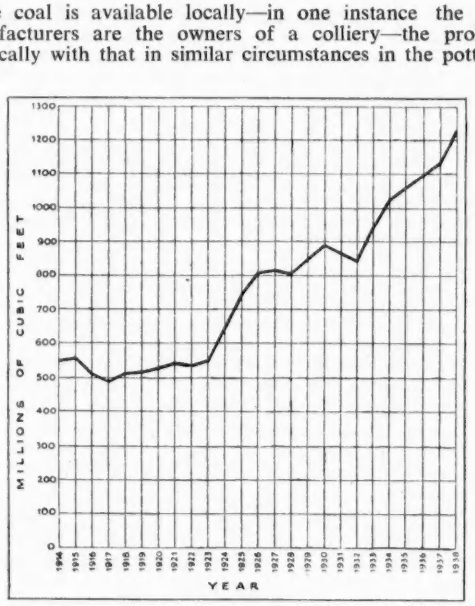


Fig. 1
Annual Outputs

has been to compete with a view to providing incidental economies to counteract additional fuel costs.

Graphs (1) show the growth in the gas consumption at three St. Helens glassworks since 1930. Two interesting points in connexion with the graphs are the drop in consumption at all these works in 1932 (a year of depression); and the rapid increase in consumption at works "A" and "B" since 1935, following the signing of an agreement for the supply of gas at the following rates:

Consumption of 60,000 therms per quarter (at one works)	4.7d. per therm.
All consumption over 60,000 therms per quarter (at one works)	3.7d. per therm.

Subject to a net cost of coal clause.

While referring to the price of gas, it should be mentioned that owing to increasing costs since 1935, both in five years of peace and three months of war, the price under the agreements has been increased by negotiation from Jan. 1, 1940, to 6.2d. per therm and 5.2d. per therm on the respective scales. Further, one new load has since been secured at these prices which is growing rapidly to 174 million cu.ft. per year, and another which will grow to 45 million cu.ft. per year. Also other works are installing plant for new loads of similar importance. Glass works loads are in many cases 168 hour per week loads and are, therefore, useful for levelling up peak loads. They, however, fluctuate considerably according to glass works arrangements.

These successes have been achieved by the satisfactory cost and performance of Town Gas in regard to those utilisations and manipulations to which it has been applied, and particularly, we believe, by the close co-operation of our staff. I think we have convinced the skilled technologists and managers of the various glassworks that our one desire is to give service of the best order with promptitude, continuity, and quality, and at the lowest possible price, realizing that any load secured is essentially competitive with (1) producer gas, (2) oil, (3) electricity.

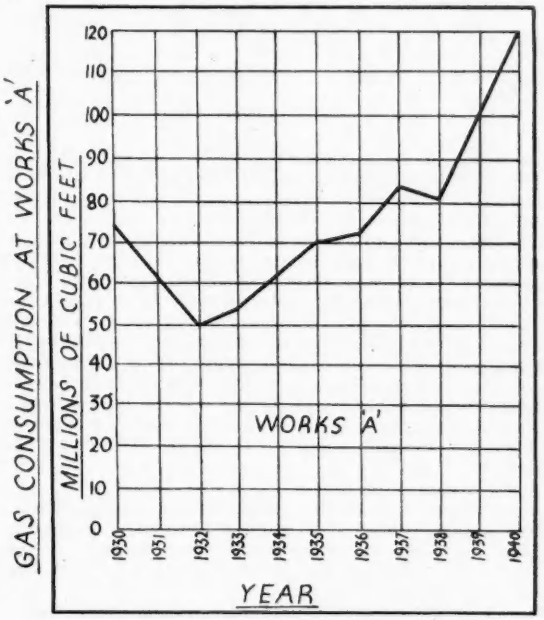
Comparative Costs of Fuels and Potential Loads

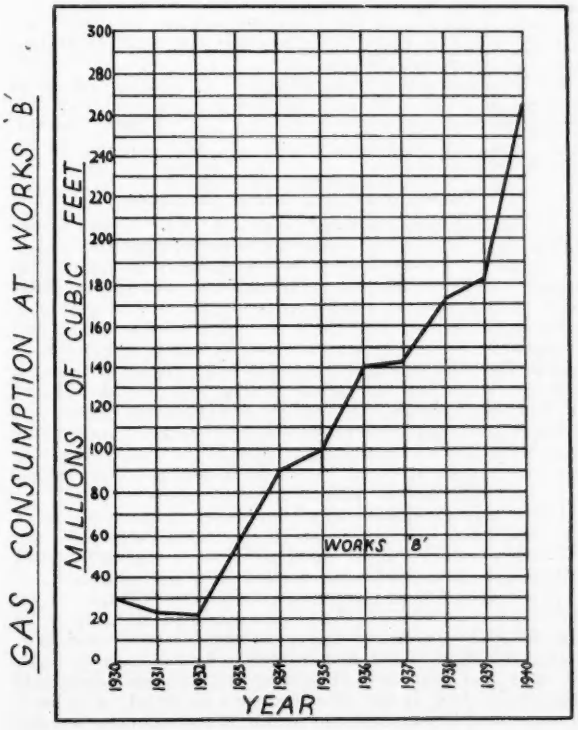
The potential town gas load is 100% of the enormous heat requirements of a glass works. The actual load will depend on cost and service in competition with other fuels.

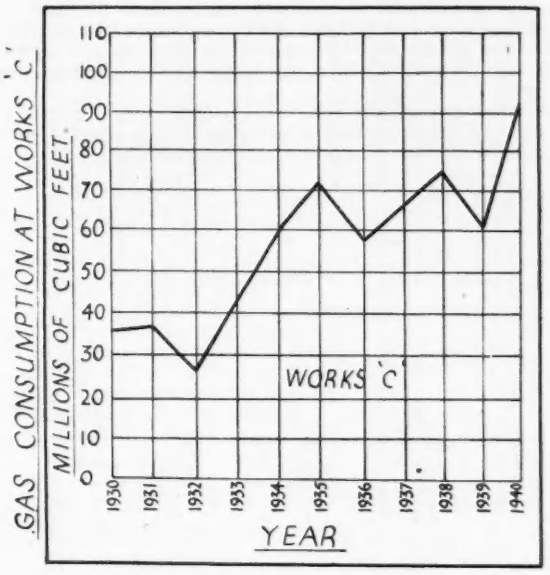
A typical works may use:

1. Coal. 1,000 tons per week to producer gas.
2. Oil. 62 tons per week.
3. Gas (town). 5 million cu.ft. per week.
4. Electricity. ½ million units per week (power and heat).

Town Gas v. Electricity.—The comparative costs of gas and electricity are readily examined by use of the accompanying nomogram. This nomogram was originally produced by the Industrial Gas Centres and is reproduced with their permission. With its aid and a knowledge of the efficiencies of application of gas and electricity and the relative prices offered, it is easy to show which is the cheaper fuel. In the writer's opinion, study of the nomogram will show that electricity cannot normally be sold at a competitive price for heat treatment. The main use of electricity in a glass works







Graphs I

will therefore be for power, and here alone it enjoys special advantages. For example, large numbers of electrically-heated lehrs for annealing glass have been installed; but several have been converted back to gas, which, on test, is effective and cheaper, and I have confidence that most of the others will be converted. The load concerned is enormous. The heating of lehrs will be referred to later.

Town Gas v. Producer Gas and Oil.—So far as producer gas and oil are concerned town gas has not such an easy victory as to cost, and has to rely on its superior adaptability, availability (much or little at a moment's notice, always on tap), cleanliness, controllability, purity, reliability, labour saving, plant saving, and waste saving.

It is obvious that ten such important points are considerations which no far-seeing manager can afford to neglect, so that even where producer gas is costed at under 3d. per therm and oil is taken as 2½d. per therm, town gas can be shown to be economic at a much higher figure. Washed producer gas is a severe competitor but has the disadvantage of a very low calorific value. Its use is therefore limited to cases where more heat in a confined space and a higher flame temperature are not required.

There is a general consensus of opinion among technical men in the glass industry that for small-scale melting and for all subsidiary heating processes, town gas is superior to either producer gas or oil because of the advantages outlined above —advantages which far outweigh any higher cost and which make town gas cheapest in the long run. For larger tank and pot furnaces, however, cost becomes the first consideration and so the primary melting process for almost all commercial glasses produced on a large scale is normally conducted with either producer gas or oil.

Coke oven gas is being supplied to the glass industry in considerable quantities for use on melting furnaces, notably in the Tyneside area, and at Rotherham and Barnsley.

Town gas has many advantages over producer gas and oil in relation to purity and freedom from dust, freedom from H_2S, low sulphur content (CS_2), lower CO content, &c., but it may be purified further with activated carbon and thus be more acceptable for special uses. Whether the need for CS_2 extraction can be avoided by improved furnace design is an interesting consideration. In this connexion one St. Helens works uses a Carbo-Union activated carbon plant and produces 19,000 gallons per annum of benzole spirit which the gas-works purchases. Interesting experiments are proceeding.

The subject of the purity of gas in connexion with annealing is an important item, and some knowledge of the various arguments is of value because oil, electricity, and producer gas are used in competition with town gas for annealing and it is possible to lose or secure a valuable load according to circumstances and knowledge of requirements. For example, one manufacturer may decide on electricity for annealing because he feels this will avoid "bloom" on the glass and save a washing process. He will perhaps use a fan and have

to burn gas as well to work the electric lehr. (Almost invariably gas is used to bring electric lehrs up to temperature from cold and for maintaining heat during stoppages. While working, the bottles themselves bring most of the heat into the lehr.)

Another will say: "The bloom comes from the sulphur in the gas, and therefore I remove the sulphur and use gas." Another will say: "I prefer bloom on the glass, it denotes strength. Some firms would not buy glass without bloom on it." In this case an open fired lehr burning producer gas would be used in preference to a muffle lehr (whether heated by oil, town gas, or electricity. Another will say: "I feel that much of the bloom comes from oil, grease, and dust anyway, and the strongest bottles come from producer gas-fired lehrs. These bottles have the heaviest bloom, but even then while these bottles are stronger than those from the gas-fired lehr, it is the open condition of heating which has the biggest effect in regard to strength."

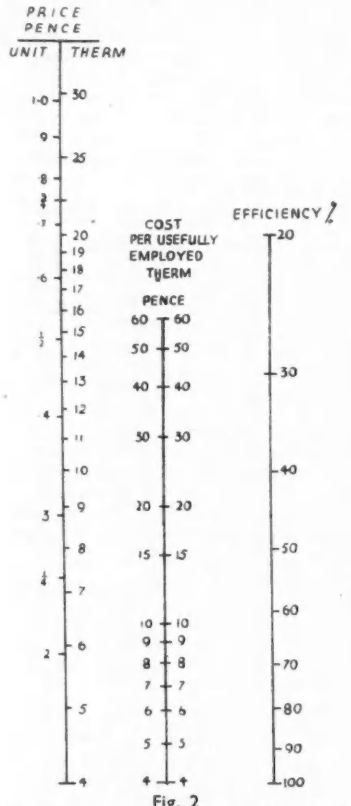


Fig. 2
Nomogram for comparing Effective Cost of Gas and Electricity

COMPARISON OF GAS AND ELECTRICITY PRICES

With acknowledgment to the G.L.C.C. Centre

The attached nomogram provides a quick and convenient means of comparing both the prices and the effective running costs of gas and electricity for any process. On the left hand line the prices can be compared directly—e.g., 0.6d. a unit is seen to be equal to 17.6d. a therm. By laying a straight edge across from the price to the efficiency, the effective price can be read off. For example, if electricity at ½d. per unit is used in an 80% efficient furnace or lehr, the cost of each usefully employed therm is 18.3d. If the electric furnace or lehr was replaced by a gas-fired one with an efficiency of 55% andgas at 6d. per therm, the figure would be reduced to 11.0d. With gas at 4d. per therm and 60% efficiency the figure would be only 6.7d. per therm

When the seemingly contradictory points are understood it is possible to realize why town gas is more and more coming into its own for glass annealing, and by adopting suitable furnace design—muffle, open or radiant tube type, with low sulphur content gas in certain cases—the simplest, cheapest, and most reliable service may be given.

Heat Requirements for Glass Making

The process of glass-making demands heat for:

1. Metal melting.
2. Refining.
3. Re-heating.
4. Conditioning at feeders and elsewhere.
5. Annealing glassware.
6. Fire finishing.
7. Heating moulds.
8. Cutting and cracking off: (a) diamond-cum-gas flame; (b) oxy-coal gas flame.
9. Re-annealing.
10. Pot and furnace drying.
11. Glass blowing.
12. Standby and precautionary heating.
13. Warming up.
14. Fine temperature control.

For metal melting and refining, producer gas is largely used and is made from coal, anthracite, or coke. Incidentally, the development of the use of coke in glass works would form a subject in itself, and a few notes on coke appear at the end of this Paper. Types of producer commonly in use include: (1) Chapman, (2) Morgan, (3) Docking, and (4) Siemens.

Although gas engineers produce gas they heat their own retort settings with producer gas from coke; hence it can be understood why the glass manager uses producer gas, and in some cases oil, to heat his large refractory glass-making furnaces. The accepted consideration here is fuel cost.

The heavy work is done with tank furnaces (see diagram I); the batch is melted and in the cases of most commercial glasses is fined at 1,500° C. The process of fining simply consists in getting rid of bubble by making the glass so hot, and therefore so fluid, that these bubbles rise easily to the surface and burst.

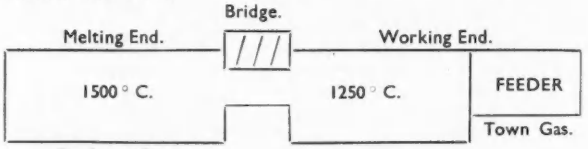


Diagram I

Feeders.—The glass is melted, and "fined" at 1,500° C. at the melting end of the furnace and flows past a bridge to the working end, then along feeders to bottle machines or other manufacturing processes. In some cases oil, but usually producer gas, is used for the melting or refining, and town gas is almost invariably used at the feeders. The gas consumptions at the feeders can only be described as enormous and, apart from use for fine temperature control of sheet and plate glass, is perhaps the most important use of town gas at glass works. The reason why gas is preferred here is because "it just beats oil or producer gas in practice." A feeder, being a refractory trough along which flows molten glass from the working end of a glass tank on its way to the process or bottle machines, has rows of gas burners playing flame on to the glass and the temperature at the bottle machines is controlled by—

(a) Varying the length of the feeder.

(b) Varying the number and size of the town gas burners.

One St. Helens works alone uses 1 million cu.ft. of town gas per week at feeders controlling the glass temperature according to the size of bottles required, and at the same time conditioning the glass.

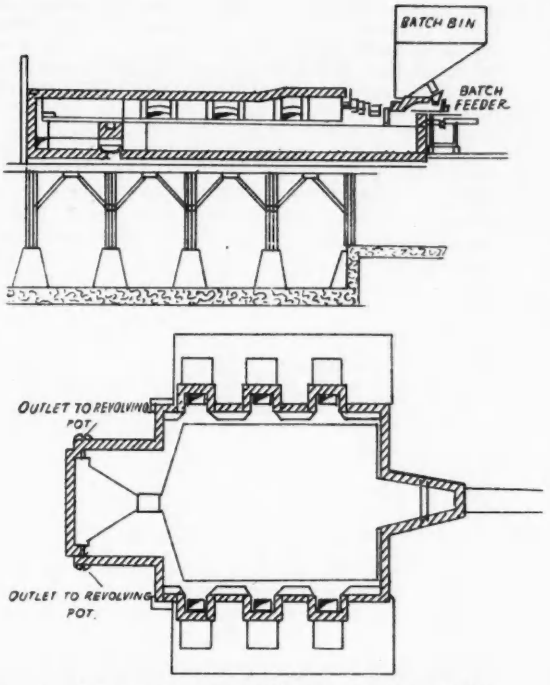
The B.C.G.A. booklet—"A Thousand and One Uses for Gas, Volume XXII, No. 239—Town Gas in the Manufacture and Manipulation of Glass," did not discuss the use of gas at feeders, and as this is, as stated, often the largest utilization it should be specially noted.

Pot Furnaces.—For some work pot furnaces are used and here producer gas and oil are usually employed, but for particular work town gas is coming into its own. Several large town gas fired pot furnaces are now working in St. Helens.

Developments in Glass Furnaces

To follow the processes logically, one must realize that glass is first manufactured and then manipulated. Glass is a state of matter, and it is the name of a commercial product. The product is fashioned into sheet-glass, plate-glass, glass bottles, oven ware, optical glass, and all the other commercial forms. The chemical action of the constituents of glass (the batch) is brought about by heat. The composition of the batch controls the quality and type of glass in the first instance. The method of heating and the control and application of the heating medium determine the quality and strength of the glass thereafter. The products of combustion have been shown to affect the quality of the glass where they come into contact with it. Also the evenness of the heating will affect the physical uniformity of the glass.

Up to 1860, glass was melted in pots set in furnaces directly fired with wood or coal, just as gas retort settings in our Industry were direct fired. Similarly, just as regenerative and recuperative principles were applied to retort settings, so in 1860 the glass industry experienced a great revolution by the introduction of the F. & W. Siemens furnace, with the use of regeneratively pre-heated air and producer gas, and later the introduction of the tank furnace. For outputs of about 20 tons per day and upwards the modern cross-fired regenerative tank is still almost alone considered. For lower outputs there is a tendency in favour of the recuperative tank.



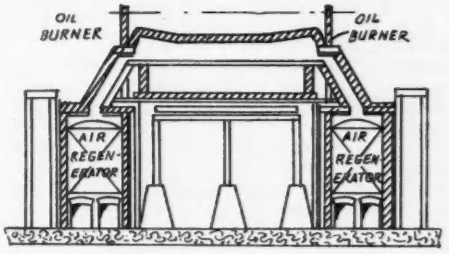


Fig. 3.

Regenerative Tank Furnace with Suspended Crown.

In recent years the recuperative pot furnace has been introduced. But generally the tank furnace is used for all scale work, such as sheet-glass and mass-produced bottles, whereas pot furnaces are used for the better classes of glass, including optical glass, produced in relatively smaller quantities per furnace. The optical glass pots are generally special town gas fired single-pot furnaces, for in a small pot furnace glass quality may be controlled by stirring, by keeping the products of combustion out of contact with the glass, and by exact temperature control.

Glass Tanks

(1) **Regenerative Tanks.**—The modern design of high-production regenerative glass tank is still essentially based on those principles put into operation by Messrs. Siemens—*i.e.*, both gas and air are pre-heated and the direction of the burning gases across the furnace periodically reversed. The producer gas and air are reversed periodically by means of special valves and recover as much heat from the waste gases as possible. The gas and air premix so that full temperature of combustion is available as soon as gases emerge from the fan-shaped ports, and thus a luminous flame is caused to radiate heat over as large an area of the tank as possible. The furnaces have a suitable stack and robust and rigid steelwork bracing. The gas engineer will have in mind simple retort settings as a comparison. Figs. 1, 2 and 3 are reproduced by courtesy of Messrs. Stein & Atkinson, Ltd., from

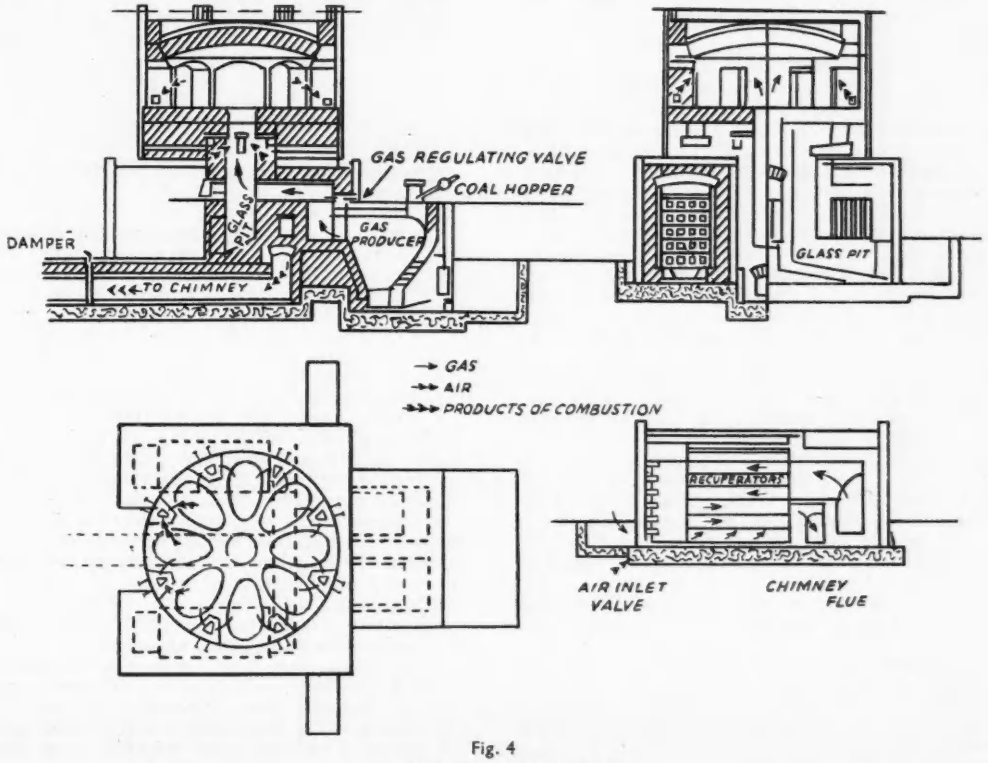


Fig. 4

Eight-Pot " Stein " Furnace

which features of construction are apparent. It should be pointed out that these are oil-fired furnaces and so do not show in the understructure the familiar double regenerator chambers of the Siemens type of furnace. In the cases of sheet- and plate-glass tanks, capacities up to 1,200 tons a day are in operation and fired with producer gas.

(2) **Recuperative Tanks.**—Recuperators incorporating dust settling chambers have been applied to small glass tanks and the maintenance, as well as first cost, are lower than with regenerative tanks. The principles of recuperation are well known to the gas engineer, and no further detail is necessary.

The recuperative principle is applied to small tanks up to 6 tons per day capacity, known as day tanks, and here the recuperator is often built in the form of a chimney. Automatic control of temperature is a feature of these tanks, particularly with revolving pots for Owens machines.

Firing and Drying-out Tanks.—Natural or coal gas is considered almost indispensable in America for starting because of its ease of regulation, and because oil has such an intense flame, and producer gas is too uncertain in its behaviour used in small streams in a cold furnace; but coal is principally used in St. Helens.

(3) **Glass Pot Furnaces.**—There are several types of pot furnaces in use. Many of these are fired from independent gas producers, though some are built with their own producers, rather similar to the coal gas retort setting producers of our own Industry. One of the best known pot furnaces is that of Messrs. Steins, introduced in France in 1922, and of which there are now hundreds working in many countries. Fig. 4 shows an eight-pot Stein furnace. The use of coke for these producers is not unusual. Recuperation is introduced under natural draught. The burner is central and the products of combustion flow along downtakes to the recuperators. The "eye" of the furnace receives the gas from the central uptake and a number of air ports are provided such as to ensure a mellow flame filling the entire furnace chamber enveloping the pots on the "siege." The waste gases are reduced to 250° C. before entering the chimney.

Coke oven gas is used in parts of this country, and in this case the admission of a small amount of steam has been found to be advantageous in delaying combustion in the heating chamber to spread the flames through the chamber and to prevent carbon forming in the chamber eye.

Insulation of the furnaces is an important item in reducing fuel costs, and is a factor which should help to secure the use of producer gas or low-priced town gas. Just as single-pot furnaces for special uses may well be fired with town gas, it seems certain that as glass manufacturers use town gas more and more they will realize that it is capable of wider and wider application.

Annealing

The annealing of glass bottles and ware in lehrs has been referred to. In this connexion both comparative costs and effects of competitive fuels may be misleading unless a full knowledge of the subject is obtained and like conditions compared. For example, Messrs. Stein & Atkinson's lehrs have auto-stackers which feed bottles quickly and uniformly hot into the lehrs. On the other hand, hand-stacked lehrs may be filled with bottles, say, 6 at a time, with the aid of forks—one bottle may be fed in black and another red. The uniform temperature of, say, 500° is required. It will be evident that comparisons between lehrs fed with auto-stackers should not be made against lehrs fed with hand-stackers.

Again, if gas is used to cover much of the heat requirements of a lehr and electricity to cover the rest, the cost of both must be taken into account when comparing with an all-gas lehr. In support of this argument, a study of costs as published for various work will illustrate the need for extreme care in making comparisons.

There are numerous types of annealing lehrs in use in the glass industry, but they can be divided into two main classes—

(1) The open-fired lehr, using producer gas, oil, or town gas as fuel and allowing the products of combustion to come into contact with the ware which is transported down the lehr by a slat conveyor belt. This is the older type of lehr and is largely being replaced by

(2) The muffle type of lehr, introduced more than a decade ago, where the products of combustion do not come into contact with the ware, which emerges clean. The bulk of these lehrs are oil-fired, but town gas and electricity are alternative fuels, and in this field town gas is competing satisfactorily with oil and has a big future. Several instances can also be quoted where town gas has now replaced electrical heating on muffle lehrs.

The introduction of the muffle lehr also saw the introduction of the "Mattress" type of lehr belt which marked a most important step in the modernization of the glass annealing department, and it is now safe to say that it is only a matter of time before the old slat conveyor type of lehr will disappear entirely. In addition, heavy cast-iron plates are fixed below the return belt and hold the heat in the lehr during any variations in load or short stoppages.

Among the best known muffle lehrs at the service of the glass industry may be mentioned: (1) The "Hartford" lehr of Messrs. British Hartford-Fairmont Syndicate, Ltd., which is put on the market in three forms—(a) for oil-firing, (b) for town gas firing, and (c) for electrical heating—and (2) the "Charlton" lehr of Messrs. Stein & Atkinson, Ltd., and briefly described by them shortly after it was put on the market in this country in "Modern Industrial Furnaces. No. 5," A Special Glass Works Supplement (1936).

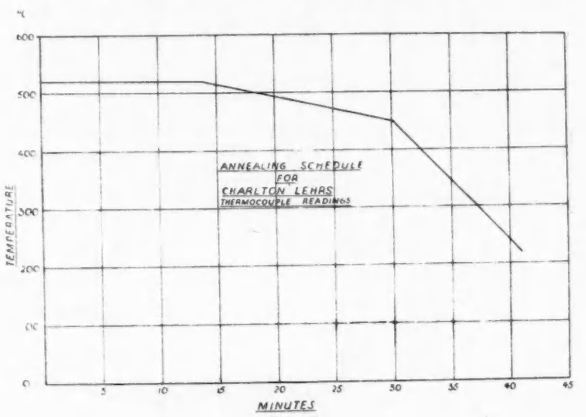


Fig. 5

Temperature Section of Lehrs

In all lehrs strict attention has to be paid to the rate of cooling of the glassware as it passes down the lehr, and in the various sections of the lehr the temperature is adjusted accordingly. The following is a brief description of the various temperature sections in the "Charlton" lehr:

1. The temperature adjusting section, occupying the first few feet of the lehr.
2. The annealing section, also heavily insulated. The temperature over this section is practically constant.
3. The slow-cooling section, where the insulation is reduced. Over this section the temperature falls at a predetermined rate to the lower annealing temperature.
4. The fast-cooling section, occupying the remaining part of the tunnel, carrying no insulation, and provided with a two-fan cooling system.

While referring to Temperature and Glass, the following is interesting:

1. The softening temperatures lie between 400° C. and 800° C., depending upon the composition.
2. Each glass has an "upper annealing temperature—namely, That temperature at which 95% of the original stress in the glass is removed within 3 minutes, say, about 630° C., and a "lower annealing temperature"—*i.e.*, the lowest temperature at which strain is removed from glass. The vital factor is the cooling rate between this temperature difference.
3. The viscosity of glass increases tenfold when the glass cools from 1,300° C. to 1,000° C.

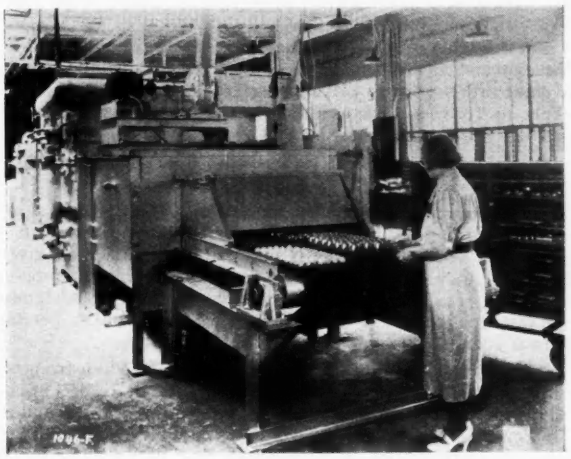
The significance of this is that all processes involving the conversion of liquid glass into a solid article, whether in flat or moulded form, depend for success upon the forming operation being carried out when the glass is at the right viscosity. The viscosity varies so greatly with temperature that the need for precise temperature control becomes obvious. This has a great deal to do with the superiority of town gas over other forms of heating because of the ease with which it lends itself to accurate control.

Digressing a moment, the rapid development during recent years of so-called toughened glass may introduce a new field for the use of town gas. Toughening consists in subjecting finished glass plates or articles to a thermal process by which they are heated to the softening point and rapidly cooled. Here again, temperature control is very important and has, in the case of flat glasses, been achieved in part by electrical heating. It is not inconceivable, however, that, more particu-

larly in the case of articles other than flat glass, town gas will have its wider uses.

In view of the wide variation in weights and sizes of glassware, some provision must be made, not only for adjusting the degree of cooling in lehrs, but for making adjustments to the rate of cooling during the critical or slow cooling range. An extremely simple and highly accurate system has been developed to permit of this. An exhausting fan is provided at the end of the slow cooling section of the lehr, the outlet from which is connected to the inlet of a blowing fan arranged at the end of the lehr tunnel. By means of a special arrangement of dampers, either hot, cold, or any intermediate temperature of air can be circulated at will. If it is desired merely to cool the ware without disturbing the annealing zones, the required amount of air is delivered by the blowing fan, and the exhausting fan so adjusted that a balanced draught is obtained. The insulation is arranged to give comparatively slow cooking for normal loadings, so that it is often desirable or necessary to increase the rate of cooling. In this case the fans are adjusted to create a draught up the lehr. Besides hastening cooling this has the effect, by recuperating some of the heat lost by the ware, of increasing the temperature in the front or hot portion of the lehr. For small loadings the result is that any heat which would otherwise be used is avoided, or reduced. In the case of heavy loadings any excessive temperature is avoided by raising the adjustable pans. To indicate the relative proportions of blown and exhausted air in the tunnel a small gas jet is fitted inside the insulated portion, which may be observed through a mica window. The appearance of the jet shows at once the direction and relative velocity of the draught.

For special requirements, such as pressed ware, the drum heater is eliminated and heating is introduced under the belt at the front end. For such purposes the side heaters are also



Radiant Tube Heated Enamelling Lehr

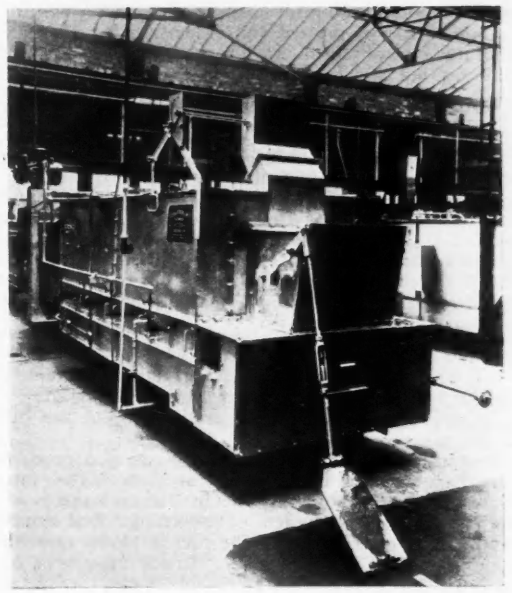
usually extended in length. In addition to the main heaters, a gas bar burner is introduced below the belt, consisting of a gas pipe containing a number of small jets. The gas consumption, and the effect on the temperature of the lehr, of this burner are negligible, but it provides a simple means of imparting a little extra heat to the bottom of the ware when desirable. In addition it gives a " bloom " to the glass, which is sometimes deemed advisable. This burner is also convenient in that it illuminates the interior of the lehr, allowing the operator to see clearly the way the ware is being stacked.

The initial heating up from cold is arranged for by a set of gas burners which are directed inside the front end of the tunnel. The lehr can be heated up from cold to full working temperature in about 16 hours using about 480 cu.ft. of town gas per hour.

The running costs of the " Charlton " lehr are extremely low under any conditions. The gas-fired lehrs have a series of special gas burners of the radiant type, and an accurate system of thermostatic control enabling the correct upper annealing temperature being maintained with all conditions of loading. Town gas permits of easy control and is superior to oil in that combustion may be developed without the use of separate combustion chambers. The necessity of the latter where oil is employed is a serious disadvantage.

As instances of town gas heated lehrs, two of these have been installed for annealing blown tumblers. The average loading on each lehr is 11 tons per 24 hours, with an average gas consumption of 350 cu.ft. per hour.

Two photographs are reproduced, showing a town gas heated " Charlton " lehr which Messrs. Stein & Atkinson, Ltd.,



Town Gas Heated " Charlton " Lehr

have recently constructed and a radiant tube type enamelling lehr constructed in America by their Associates, the Surface Combustion Corporation. With regard to the town gas " Charlton " lehr, the one illustrated has an effective belt width of 1 ft. 4 in. and is suitable for a maximum output of about 6 tons of bottles per 24 hours. Several similar lehrs to this have been installed, and the gas consumption when working continuously averages about 50 cu.ft. per hour.

In certain cases these lehrs have been used for serving hand machines where work is only carried out during the day shift and there are also stoppages for meals. Under these conditions the gas consumption averages between 75 and 85 cu.ft. per hour overall. With these small town gas heated lehrs the principal patented features of the larger " Charlton " lehrs are generally embodied, and heating is effected by a series of

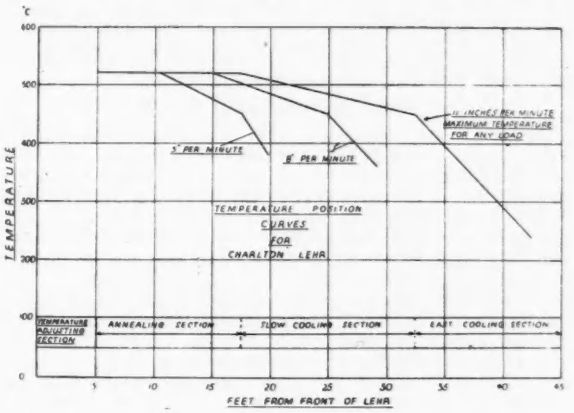


Fig. 6

Fig. 6 shows typical temperature curves for different loads and indicates periods comprising the annealing schedule

special radiants thermostatically controlled. The temperature control with this system is extremely accurate, and no difficulty is experienced in obtaining the correct annealing schedule with the most varying loads.

The radiant tube heated lehr is heated by gas-fired radiant tubes specially arranged both above and below the glassware. A special system of circulating fans is embodied which draws

the hot atmosphere from the top of the tunnel over the heating section and delivers this underneath the belt and up through the glassware. By this means evenness of temperature is satisfactorily maintained throughout the section of the tunnel also rapid soaking of the glassware to the right temperature is obtained.

The firm have at the moment, under construction, similar lehrs in this country both for enamelling glassware and for the annealing of special pressed and blown articles.

With this type of lehr in America it is most usual to employ natural gas, but over here, of course, either town gas or clean producer gas is used. The town gas applications are by far the largest as suitable clean producer gas is only available in a limited number of works. A very accurate system of temperature control is introduced and there are, of course, no products of combustion in contact with the glassware.

As an example of the performance of a 4 ft. radiant tube enamelling lehr, town gas-fired, the capacity may be taken as about 160 gross of bottles per 24 hours and the average gas consumption about 1,500 cu.ft. per hour.

One 30 ft. lehr working in St. Helens has burner equipment designed by the City of Birmingham Industrial Research Laboratory.

Glory Holes

Glory holes are used for re-heating glassware evenly in a very short time preparatory to shaping with tools, &c. They may be fired with coal gas, oil, crude creosote, tar oil, or producer gas.

The simplest form of glory hole consists of a rectangular fireclay box made of either bricks or slabs. The interior measures about 12 in. by 9 in. by 9 in. In each side is a hole into which the ware is inserted for re-heating. One apparatus serves two sets of workmen. The fuel is blown through an opening in one end of the chamber. Crude creosote or tar oil are popular, but the coal gas glory hole is clean, easily regulated, takes up little space, is cheap to instal, and does away with fuel handling and storage. A test with a gas-fired glory hole, softening bottle necks, was reported as follows:

Gas consumption per furnace per hour 60 cu.ft.

Output of bottles per hour per furnace—2½ gross.

Optical Glass

Because of the careful regulation of conditions required in melting optical glass, single furnaces, approximately cubical in shape capable of holding one pot only are almost universally employed. Heating is by means of town gas.

Fire Finishing

Automatic pressed ware is "finished" at great speed, such as demanded by the rapid production. Ware is polished by being passed through a small furnace called a "glazer" or "melter." A coal gas flame is used in this fire-polishing process.

Ware is often carried in revolving cups underneath and through a gas flame which melts and glazes the edges, and these are finished to any desired pattern while the edge is plastic. Intensely hot flames are used for cutting off, and ware is revolved in front of adjusted slits firing coal gas to produce a controlled fracture.

Window and Plate Glass

Tanks for producing sheet and plate glass may melt at 1,200 tons a day capacity, and feed into 300 ft. lehrs, with both producer gas and coal gas in use. In many factories at one time the flattening ovens used in connexion with cracking open blown cylinders of glass and flattening into sheets were heated by coal gas. Nowadays no glass is made at St. Helens, and very little elsewhere, by the cylinder process followed by flattening. It is now made by drawing a flat sheet of glass vertically upwards from the bath of molten glass. Once more, fine temperature control at the point at which the sheet is formed is most important, and the only source of heat that has been successful is, I think, town gas or washed gas, mainly the former. In this process, town gas burners are installed for standby and fine control, and for dealing with cracks.

The bulk of the plate glass output is made by rolling a continuous ribbon. Town gas is used to assist in maintaining uniformity of temperature across the width, and at the edges of the ribbon just before and after it is formed. It is also used on auxiliary feeders for producing the top layer of wired glass.

Use of Gas in Glass Research Laboratories

Anyone would feel privileged to be conducted over local Glass Research Laboratories, and recently the writer had that privilege.

The lay-out and equipment is extensive and unique. The refractories section forms a foremost part of the laboratory's activities, and here a 6-in. gas main serves furnaces, firing and testing experimental refractory glass-pots producing glass from research batches. Gas is also extensively used for the general and routine laboratory purposes.

When one sees the exact control and investigation with the aid of the finest microscopes, X-ray apparatus and instruments of all kinds obtainable, one realizes that the scientific utilization of the various fuels including town gas are also subject to direct investigation of a most scrupulous order. Therefore any claims made are subject to the test of knowledge and achievement. This is a satisfactory position, as practical applications of gas can always obtain judgment at the hands of expert scientists, and I am confident that such control will in the future find wider uses still for our scientifically produced and scientifically applied fuel.

The Uses of Coke in Glass Works

As a Reducing Agent.—Reducing agents (though objectionable in some cases as with lead glass) may be valuable and useful for incorporation in a "batch" of some batch forming oxide, or for the production of requisite conditions for the formation of particular colours, by extraction of oxygen from some component batch. Coke is used as the agent for the former type of reduction and stannous oxide for the second.

Simon-Carves Producer Gas Fired Glass Furnace.—Fuel costs can be further reduced by the use of gas coke for firing the producer.

Building of Glass Melting Tanks.—The preliminary heating is done by coal or coke fires. It is important to heat the tank as slowly and uniformly as possible. The time taken to heat up a tank furnace varies from a few days to a month, depending upon the size and the ability of the refractories employed to resist temperature differences throughout their thickness.

For Lighting up Coal Producer.—A wood fire is started on the clinker-bed. When this is going well, coke is added until a good fire is going. Coke is preferable to coal as it is less likely to form a sticky clinker. Coke is used to maintain the fuel bed during "burning out" of gas mains.

Steam Boilers.—Coke is extensively used in glass works steam boilers.

In Producers.—Bituminous and anthracite coals give a gas with a considerably higher maximum flame temperature than does coke. For this reason it may happen that with a given furnace it may easily be possible to get the required temperature using coals and quite impossible to do so with coke. Against this, coals are far more apt to cause clinker trouble than is coke.

An even more important distinction is the freedom from tar with coke and anthracite coals. If bituminous coal is used, and the gas allowed to cool, tar will be deposited in the mains. This can be got rid of by occasionally shutting off the gas, opening up the mains to atmosphere, and allowing the tar to burn away. Unfortunately this is not always possible. For example, a furnace may be required to run absolutely continuously for several years at a stretch. In this case it is advisable to use coke or anthracite as a fuel.

The tar difficulty can be overcome by some types of gas-cleaning plants, but these are probably rather too elaborate for use with small units. Naturally, if the producer is very close to the furnace, and the gas remains at too high a temperature for the deposition of tar, this objection to bituminous coal need not be taken into consideration.

Coke is a very suitable substitute for anthracite in gas producers, and valuable research work has been done at one glass works in conjunction with the London and Counties Coke Association and the St. Helens Gas Department. Difficulty with tar produced from coke has been overcome at certain glass works, but not at others. Coke is certainly the cheaper fuel, even after allowing for a lower make of producer gas per ton. Any tar produced may be removed by the patent "Murex" process—washing the gas in purifiers containing coke saturated with oil.

The P.G. mechanical gas producer fitted with Koller patent revolving grate is designed primarily for the gasification of low-grade fuels such as gas-works and coke oven coke and breeze. The standard ranges for capacities of single units are from a minimum of 4 tons to a maximum of 60 tons of fuel per 24 hours.

Figures given by the suppliers in a log sheet for a week's run of one of these producers include the following:

Fuel.—Coke Breeze.

Grading—		Average Analysis	
Larger than 1 in.	Nil.	Moisture	14.3%
Between 1 in. and ½ in.	7·4%		
„ ½ in. and ¼ in.	22.8%	Dry Ash.	14.3%
„ ¼ in. and ⅛ in.	25.4%	Vol.	3.8%
„ ⅛ in. and 1/16 in.	16.9%	T.C.	81.9%
Below 1/16 in.	27.5%		

Total consumed in 168 hrs., 44.9 tons.

Gas.—Average Analysis.

CO_2	5.8%
CO	25.1%
H_2	9.1%
CH_4	0.68%
N_2	59.32%

Yield per ton of fuel, 132,500 cu.ft.

The "Wellman-Galusha" producer is intended for the gasification of anthracite beans or coke breeze, graded as small as ½-in. to 3/16-in. mesh. The makers give the following capacities for the four sizes in which the producer is supplied:

Diameter.	Anthracite Gas. Cu.Ft. per Hour.	Coke Gas. Cu.Ft. per Hour.
10 ft.	153,000	142,000
8 „	101,000	94,000
6 „	50,000	46,000
4 „	18,000	16,700

Conclusion

Reverting to Graphs (1) A, B and C, the gas consumptions at these glass works during the current year are rapidly increasing and the figures shown for 1940 are safe estimates based on consumptions to date, while the popularity of gas is increasing in connexion with water heating, space heating, and canteen work collaterally with industrial uses. The reasons for this are various, but undoubtedly much of the increase is due to effort in that direction by the Gas Department's staff.

Finally, I desire to acknowledge the willing co-operation of the managements and staff of Forster's Glass Co., Ltd., Pilkington Bros., Ltd., and United Glass Bottle Manufacturers, Ltd., and facilities afforded in connexion with this Paper.

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Auxiliary Hotplates

Patent No. 525,352 (application date, Feb. 18, 1939), taken out by General Gas Appliances, Ltd., and H. C. W. Bennetts, concerns the provision of means for increasing the available hotplate area of gas cookers. According to the invention, an auxiliary hotplate is provided adapted to be detachably secured at the side of the cooker.

In one example the cornice of the gas cooker supporting the parts of the hotplate is formed with two notches at each side and adapted to receive the hooked ends of brackets so that these hooked ends may be flush with the cornice. Two auxiliary hotplates are provided, one for each side of the cooker, each having a cornice of the same length from back to front as the main cornice. The hook-shaped brackets are adapted to pass below the cornice and to be secured thereto at either side so as to support one cornice from the other at either side as may be desired, close to and level with the main cornice.

Each auxiliary hotplate comprises two **U**-shaped end pieces of channel section joined by a top bar flush with the front face thereof, to which parts is secured a **U**-shaped metal sheet forming an open-ended and open-topped construction. The edges of the **U**-shaped plate fit into the channel of the end members and these parts are secured together by screws engaging suitable lugs on the under-side of the **U**-shaped end pieces. The bottom of the plate is slightly ribbed at each side for additional stiffness. Across the tops of the **U**-shaped ends are secured bridge pieces carrying lugs to which the cornice of the hotplate is secured, the bridge piece at the back or rear end of the hot-plate being **U**-shaped in plan and having a forwardly-projecting central lug. The front bridge piece, on the other hand, is a hollow box-like structure having inwardly projecting lugs at its top, to which the cornice is secured, and further inwardly projecting hollow lugs to either of which a gas pipe may be supplied. Secured to and depending from the bridge piece are two gas taps which incorporate gas nozzles and the ends of which are adapted to support the mixing chamber end of a burner in known manner. The two hollow lugs are drilled and screw-threaded in their side faces furthest away from each other and a hole is provided in the side of the **U**-shaped plate so that a flexible gas connexion may be taken to one of such lugs while the hole in the other lug will be closed by a screw plug.

The front of the hotplate is finished by a small panel attached across the upper part so as to cover in the front bridge piece and taps, while holes are provided through which the control spindles of the taps project and on which are fitted the control knobs.

The opening below the front panel permits plates or dishes to be placed within the body of the unit so that they may be warmed. The burners consist of one long ring type burner having an extension at the far end of the ring to rest on the lug of the rear bridge piece, while its mixing chamber is offset relative to the ring and to the extension and is adapted to be supported on the end of one of the taps.

The front of the ring immediately opposite the rear extension has a lug or web which is adapted to support the other burner. This burner comprises a relatively short mixing chamber offset to the opposite side of its ring and with a relatively long extension from the ring to rest on the lug of the other burner. In this way the two burners are supported so as to be positioned relatively centrally at the back and front of the hotplate.

A substantial cast top plate is provided for supporting cooking utensils, having a smooth top surface with upstanding ribs to hold such utensils raised clear of the plate so that the gas burners may function properly. This plate is supported at the front and back on inwardly directed flanges of the cornice, which flanges also serve for connecting the cornice to the bridge pieces. At the back of the cornice is a lug carrying a spring clip which is engaged by a projection on the cover when in the raised position so as to hold the cover in such position. A cover plate is hinged to the back edge of the cornice and a back plate is provided closing in the rear **U**-shaped member. Two rectangular holes are provided in the **U**-shaped plate at each side, through which the supporting brackets project to engage the cornice.

In use a hotplate may be attached to the main hotplate by means of its brackets so that its top is level with the top of the main hotplate, and by reason of its construction it can be placed at either side of the main hotplate. The second hotplate, which is mounted on the other side, is substantially the same in construction except that the front bridge piece is fitted with only one tap and is adapted to support a grilling burner.

Gas Undertakings Results

Aberdeen

The operations of the Aberdeen Corporation Gas-Works for the past financial year have resulted in a surplus of £19,543; the revenue having been £276,355, and the expenditure £256,812. No change is being made in the present charges for gas, but it is estimated that, with the increased rates agreed to in the early part of this year, there will be a revenue for 1940-41 of £318,881. This, with an estimated expenditure of £295,278, would show a surplus of £23,603 at the end of the current financial year.

Brisbane

A satisfactory increase in sales of gas during the six months to June last is reported by the Brisbane (Queensland) Gas Company, more than 9,000,000 cu.ft. having been sold in excess of the corresponding half of last year. A strike in the coalfields greatly affected the receipts from residuals, and also caused considerable additional expense in the production of gas. During this period the stock of coal was conserved as much as possible by the gasification of wood and oil. While economies have been effected in some items of expenditure, there have been increases in others. The accounts show a credit to Profit and Loss (inclusive of the balance from the previous half-year) amounting to £25,403, and it is proposed to appropriate from the Reserve Fund for Equalization of Dividends the sum of £2,000, making an available total of £27,403. After payment of a dividend of 3½%, there will remain a balance of £639 to be carried forward. Throughout the half-year steady progress has been made with extensions of mains and the laying of services for additional customers requiring a gas supply.

Coatbridge

The Directors of the Coatbridge Gas Company, in their report for the year ended June 30, state that the sales of gas for the twelve months amounted to 1,502,180 therms. The quantity sold during the previous year was 1,642,828 therms. The final dividends are the same as before, at the rates of £9 5s.% actual on the original stock and £6 9s. 6d.% actual on the four issues of £10 shares.

Colonial Gas Association

The quantity of gas sold by the Colonial Gas Association, Ltd., during the twelve months to June 30 last shows an increase of 14.2% upon the figure for the preceding year. The corresponding increase in the quantity sold by subsidiary gas undertakings is 3.6%. A strike occurred in the coal mining industry in Australia in the early part of this year, but after ten weeks the collieries re-opened. The Association were able to maintain a full supply of gas during this time. In consequence, however, of the general increase due to the war and also to the strike, the expenditure for the year has been considerably heavier. During the year the Maldon works had to be closed down. The recommendation of the Directors is that a dividend at the rate of 6% (less the interim dividend of 3% already paid) be paid on the ordinary shares, and that the sum of £4,000 be transferred to the credit of Renewals Account, and £1,500 to the Reserve Account.

Darlington

The accounts and statistics of the County Borough of Darlington Gas-Works for the twelve months to March last show that the gas made and purchased amounted to 719,807,000 cu.ft., as against 706,090,000 cu.ft. in the preceding year. During both years practically the whole of the gas sent out was purchased. The total sales in the past twelve months were 676,401,800 cu.ft., which compares with 679,963,944 cu.ft. in the year before. The unaccounted-for gas on the present occasion is 5.68% on the make, against 3.29%, but, on the other hand, the proportion of gas sold for public lamps is 1.57%, whereas a year ago it was 5.61% of the total. During the year 451 additional consumers were added —bringing the prepayment meter users up to 15,300. While the gross profit is little changed, the net profit is reduced from £1,329 to £98.

Hinckley

It has been reported to the Hinckley Urban District Council that the working of their gas undertaking for the twelve months ended March 31 has resulted in a gross profit of £17,064, which compares with £14,716 for the preceding year. The net profit is £1,163, as against £732. It had been thought at one time that there would be a deficit on the year's operations. But the severe weather of the past winter led to a gratifying increase in consumption, and this, with an increase in price from the December meter readings, brought the position round to a satisfactory profit. As a matter of fact, the gross profit was stated to be a record. The net profit has not been entirely disposed of in the period under review, with the result that the working balance has been increased.

Largs

It has been reported to the Largs (Ayrshire) Town Council that the revenue from the gas-works during the past financial year was £14,594, the surplus being £3,084. Sales of gas realized £12,483, while coal cost £5,283. The outstanding loan debt on the undertaking amounts to £28,475, and the surplus assets are stated at £1,812.

Leamington

A very satisfactory balance-sheet was presented at the half-yearly meeting of the Leamington Priors Gas Company, when it was stated that the gross profit of £10,868 compared with £9,897 for the June half of 1939. A Special Order which came into force at the close of the past half-year is primarily to extend the area of supply so as to include Southam and district, but it also embraces many provisions designed to bring the Company more into line with modern practice. Total gas sales, as compared with those for the corresponding half of 1939, show a decrease of 9%. An important development in the Company's scheme of Consumers' Service has been the appointment of a Home Service Adviser.

Newark

The report of the Newark Corporation Gas Undertaking for the past financial year shows a record figure for gas made of 204,000,000 cu.ft., which is an increase of 5.7% when compared with the output of the preceding twelve months. The gross profit of £15,933 compares with £15,066 a year ago, and after providing for loan charges and income-tax, there is left a net profit of £3,175, as against £2,938. The whole of this net profit is to be used for capital provisions, including new meters, land, and water gas plant. The outstanding debt on the undertaking is now reduced to £111,256.

Oswaldtwistle

The quantity of gas distributed during the past financial year by the Oswaldtwistle Urban District Council was 98,596,000 cu.ft., which is a decrease of 6.28% when compared with the output of the preceding year. Sales totalled 88,715,900 cu.ft., which is a decrease of 10.16%. About 200 meters have been scrapped, and the testing of all meters in use is being carried on expeditiously. An increase in price was in operation for six months, while a further increase has operated from the close of the year. As from the end of the current financial year the undertaking will be relieved of loan charges to the extent of £1,000 per annum. The gross profit of £2,465 compares with £1,993 a year ago; while this year there is a net deficit of £380, as against a deficit of £1,283 last year.

Scunthorpe

The operations of the Scunthorpe Corporation Gas-Works during the past financial year, it was stated during a discussion in the Town Council, have resulted in a deficit of £1,656. An increase is to be made in the price of gas to meet the heavier working costs. From this an additional £6,000 in revenue is anticipated.

Smethwick

The accounts of the County Borough of Smethwick Gas Undertaking for the year to March last show that the total quantity of gas sold was 1,059,505,600 cu.ft., which compares with 1,023,601,100 cu.ft. in the preceding twelve months. The public lighting consumption fell from 52,603,200 cu.ft. to 15,189,200 cu.ft. The balance of revenue carried to Net Revenue Account on the present occasion is £55,326, as against £44,352 a year ago, while the net profit is reduced from £16,910 to £10,101. After the transfer to Reserve Fund Account of £19,010 (against £16,227 last year), the balance carried forward will be reduced from £24,215 to £15,306.

Message from the A.G.A.

In our issue of Sept. 18 we gave the text of a letter which Sir Francis Joseph, President of the Society of British Gas Industries, has addressed to Mr. Walter C. Beckjord, President of the American Gas Association, in reply to an invitation to attend the forthcoming convention of the A.G.A. The following cable has now been received from the President in answer:

"Your steadfast message of greetings from British Gas Industries coming in your hours of adversity is an honour to our common ideal of public service. Executive Board of American Gas Industries recognizes the unjustified difficulty that confronts the British Gas Industries and the British people, and pays high tribute to the supreme courage and devotion with which you are carrying on."

Reactions of the Consumer

At the annual meeting of the Pennsylvania Gas Association, an interesting Paper was presented by Mr. E. Roper, Consultant Surveyor of Industry and Business for *Fortune* (New York). In the course of it, he said that to analyze accurately what the public thinks about utilities is not an easy job. It is not so simple, for example, as it is to find out for the manufacturer of doo-dads whether the public would now like to have its doo-dads green or pink. The situation is complicated by the fact that this customer of yours does not form a single judgment about you; he forms three separate judgments, and what he finally winds up thinking about you is a composite of all three judgments.

In the first place, there is the judgment he passes on you when he thinks of his relations with you on a strictly buyer-seller basis. In this judgment, your prices and your services are important.

But the customer also forms a set of judgments about you as a neighbour. And bear in mind that he is often confronted with having you as a neighbour whether he wants to or not. In this set of judgments, the courtesy and the other neighbourly qualities you show are important.

The third set of judgments which your customer forms about you have to do with you as a citizen. And you are no ordinary citizen like John Smith, but a citizen of such great importance that your activities and your welfare are as much a matter of national concern as the welfare and activities of our army and navy. Translated into local terms, you are regarded as being able to help or hurt your town, which is also your customers' town.

Now, I should like to borrow from more than a dozen studies which we have done directly in the utility industry. For obvious reasons, I cannot mention names and places, because these studies were done on a confidential basis for clients who have given me permission to use such material as I have, without reference to specific companies.

When I first started to do work for utilities, I took the trouble of making a rather exhaustive enquiry as to what constituted the prevailing philosophy of the management of the utility industry as a whole, which, fortunately for me, turned out not to be the philosophy of my new clients. These two things stood out as integral and important parts of that utility philosophy: "Don't worry about rates not being low enough because these governors and commissions are so anxious to make political capital out of rates that they are constantly on our neck to drive rates down, and we have to fight constantly against any rate reduction in order to keep the rate situation in balance. Also don't worry if you find that people call utility rates high. All people call all utility rates high at all times, regardless of a justification or a lack of it."

After several years' work in the field, I find myself completely opposed to both statements. In the first place, the majority of people are not apt to call utility rates high if they aren't high. We have asked the following question in communities scattered all over the United States: "Do you regard the monthly cost to you of the following services as high, low, or reasonable?" And we have named the light bill, the gas bill, the water bill, the telephone bill, and the tax bill. Except for some confusion over the fairness of the telephone bill, we have found that, by and large, people have rather unerringly put their finger on high rates, and have been perfectly willing to call rates reasonable when they actually were reasonable.

True, we have found very few people willing to call any of these costs low, but they have used the word "reasonable" in describing them in every single instance where I personally consider the costs of these services as being reasonable. In the Puget Sound district, for example, where there are actually low electric rates, many more people called the electric bill low than called the telephone bill, the tax bill, the food bill, or the rent bill, low. In a recent survey, in a large metropolis, 42% called the cost of gas reasonable.

I think it would be interesting to examine briefly at this point the question as to who it is, what kind of a person it is, who is critical of big business generally, and the utility business specifically. I think that if I were to select the single greatest mistake most often made by clients of mine who represent big business, I should say that it was the assumption that their public relations policy had as its primary concern the poor people, "the people who have nothing except a vote," to borrow a phrase. They make the blithe assumption that the intelligent people—the doctors, lawyers, and other professional people, and those others with sufficient money to be in the "A" economic level—that all these people are on the "right side" in that they understand the problem, and that they are people business can safely regard as allies in any struggle against increased government regulation, or in any battle at the polls. I say this is the most serious mistake advisedly, because I have not found that condition to be true. Time after time our cross-tabulations have revealed that the severest critics of certain big businesses are the most educated groups, the professional people.

It has been said that all political revolutions start at the top and spread to the masses. It is my opinion that all effective demands for business reform start also at the top. Perhaps some of the politicians who seem to be embarked on an anti-business plank as a means of rabble-rousing have investigated and discovered that a considerable percentage of their most intelligent electorate is to be found among the critics of whatever business practice is under fire at the moment.

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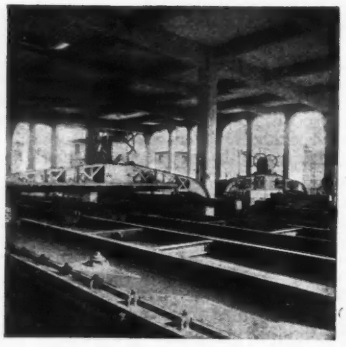

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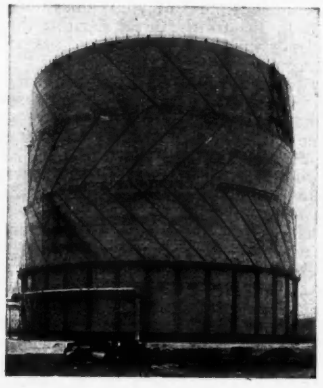

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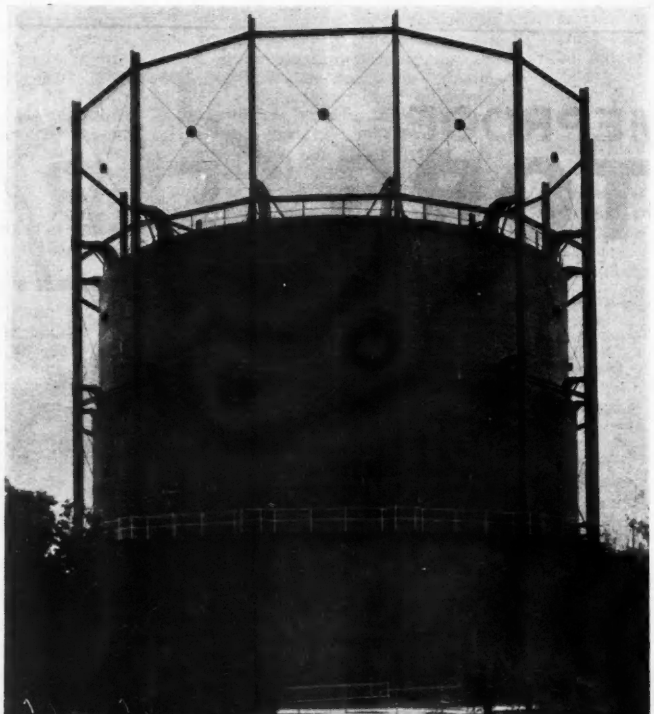

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Gas Products Prices

The London Market

Oct. 21

Prices of Tar Products in the London market remain unchanged at about the following levels: Creosote is about 4⅜d. to 5d. per gallon, refined tar 3⅜d. to 4d., the price of pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d. per gallon, pure benzole 1s. 10d., 95/160 solvent naphtha 1s. 11d. to 2s. 0d., and 90/160 pyridine about 17s. 6d. all per gallon naked, refined naphthalene crystals £23 per ton in bags, all *ex* Makers' Works.

The Provinces

Oct. 21

The average prices of gas-works products during the week were: Pitch and Crude Tar.* Toluole, naked, North, 1s. 9½d. (Controlled by the Ministry of Supply Order No. 1, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9d. to 9½d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 9d. Heavy naphtha, North, 1s. 4½d. to 1s. 5½d. Creosote, *ex* works, in bulk, North liquid and salty, 4½d. to 4¾d.; Scotland, 4¼d. to 4⅜d.; low gravity, 4½d. to 4¾d. Fuel Grade, 4d. to 4¼d. Carbolic acid, 60's, 3s. 6d. to 3s. 7½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil, (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6½d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, p. 404.

Scotland

GLASGOW, Oct. 19.

Export enquiries continue quite numerous and prices are, if anything, steadier than they have been of late.

Refined tar.—Only a moderate throughput is maintained in the home market at 4¼d. to 4½d. per gallon, while for export offers are being made at 3½d. per gallon, both f.o.r. naked.

Creosote oil.—Demand shows some improvement with prices steady as under: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5⅜d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid is also somewhat steadier with makers' prices as follows: Pale, 99/100%, 2s. 2d. to 2s. 4d. per gallon; Pale, 97/99%, 1s. 11d. to 2s. per gallon; Dark, 97/99%, 1s. 7d. to 1s. 9d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha is maintained as available at 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha.—90/160 grade is 1s. 8½d. to 1s. 9d. per gallon and 90/190 heavy naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Motor benzole is 1s. 9d. to 1s. 9½d. per gallon.

Pyridine.—90/160 grade is 17s. to 18s. per gallon and 90/140 grade is 19s. to 20s. per gallon.

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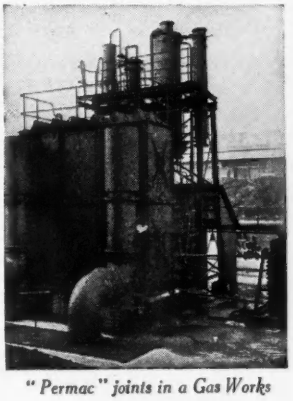
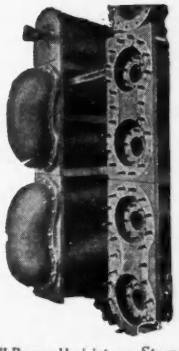


"Permac" joints in a Gas Works



"Permac" joints on Steam and Benzol Bye-product Plant. Right — covers removed for jointing.

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GAS STOCKS AND SHARES

Markets were only moderately active last week, although prices for the most part were steadily maintained. Most of the business centred round the gilt-edged section, and among British Funds several have now reached prices considerably above the fixed minima—2½% Consols closed a point higher than a week ago at 75½. A small demand set in for home rails, which caused numerous rises in both junior and senior issues. There was less activity in the industrial section, and some irregularity was noticeable towards the end of the week, though on the whole changes either way were small.

More transactions were recorded in the Gas Market last week than for some time past, but with few exceptions quotations closed unaltered. In the Official List the only change of note was a drop of 6 points in South Suburban 4% preference to 67½, business being recorded at 65, against the last transaction over three months ago at 74. South Metropolitan 6% preference also reacted, closing 3 points down at par. At the Provincial Exchanges, Bristol ordinary hardened a point to 88½, while in the Supplementary List, East Surrey preference stocks were marked down.

As in the case of many other securities, gas stocks also have suffered severely since the outbreak of war, and prices for some time past have been at such low levels that only forced sales are coming into the market. Having regard to its national importance, however, there can be little doubt that when hostilities have ceased the Gas Industry will play a large part in the many reconstruction schemes necessitated by the war. Investors, therefore, with any surplus funds may be well advised to take up any stock available at the current low prices.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Oct. 18.	Rise or Fall on Week
1,767,439	Sept. 16	7	7	Alliance & Dublin Ord. ...	102—112	...
374,000	July 1	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	May 13	5	5	Asscd. Gas & Water U'd'ts Ord.	12/—14/	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	15/6—17/6	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	12/—14/-	...
561,370	Aug. 12	7	7	Barnet Ord. 7 p.c.	100—105	...
300,000	Oct. 14	1/9⅜	1/4⅜	Bombay, Ltd.	19/6—21/6*	...
690,407	Aug. 19	7	7	Bournemouth 7 p.c. max. ...	100—110	...
362,025	June 17	4	4	Do. 4 p.c. Deb. ...	75—85	...
659,955	Aug. 19	6¾	4⅜	Brighton, &c., 5 p.c. Con. ...	65—75	-½
855,000	Sept 30	8	6	Brit. Gas Light Ord.	75—85	...
545,000	June 17	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	110—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6, '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—¾	...
626,860	July 15	5	6	Cardiff Con. Ord.	89—94	...
24,500	Sept. 23	7	7	Colombo Ord. 7 p.c. Pref. ...	19/—21/-	...
764,169	Oct. 7	-/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/-	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/-	...
1,748,935	July 22	2	3	Commercial Ord.	37—42	...
620,000	June 10	3	3	Do. 3 p.c. Deb.	58—63	...
286,344	Aug. 19	5	5	Do. 5 p.c. Deb.	88—93	...
807,560	Aug. 12	7	6	Croydon sliding scale	85—90	...
644,590	,,	5	5	Do. max. div.	90—85	...
620,385	July 1	5	5	Do. 5 p.c. Perp.Deb. ...	90—95	...
179,500	Aug. 19	5⅜	5	East Surrey 'B,' 5 p.c.	75—80	...
176,461	June 17	5	5	Do. 5 p.c. Deb. (Irred.)...	90—95	...
250,000	July 8	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	May 13	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/-	...
19,152410	July 29	3⅜	4½	Gas Light & Coke Ord. ...	13/—15/-a	...
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	54—59	...
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	70—75	...
2,993,000	July 8	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	80—85	...
8,602,497	June 3	3	3	Do. 3 p.c. Con. Deb. ...	65—70	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	99—104	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	98—103	...
700,000	Sept. 9	3½	3½	Do. 3½ Red. Deb. ...	80—85	...
5,600,000	May 13	4	8	Imperial Continental Cap. ...	35—40	...
43,820	July 29	3½	3½	Do. 3½ p.c. Red. Deb. ...	63—68	...
231,978	Aug. 19	5	5	M.S. Utility 'C' Cons.... ...	68—73	...
918,657	,,	4	4	4 p.c. Cons. Pref.	72—77	...
675,000	May 6	†4	†4	Montevideo, Ltd.	52—57	...
300,000	Apl. 29	9	7	Oriental, Ltd.	100—110	...
368,537	June 3	7	8	Plymouth & Stonehouse 5 p.c.	90—100	...
621,667	Aug. 19	8½	7½	Portsmouth & Gosport Cons.	97—102	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/-	...
597,972	,,	-/10⅛	-/10⅝	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/-	-/7⅛	South East'n Gas Cn. Ld. Ord.	9/—11/-	...
1,000,000	,,	-/10⅛	-/10⅝	Do. 4½ p.c. Red. Cum. Pref.	14/—16/-	...
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	13/—15/-	...
6,709,895	Aug. 5	4	4	South Met. Ord.	53—58	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	95—105	-3
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	65—75	...
1,895,445	July 1	3	3	Do. 3 p.c. Perp. Deb. ...	60—65	...
1,000,000	July 15	5	5	Do. 5 p.c. Red. Deb. ...	95—100	...
1,543,795	July 22	3	4	South Suburban Ord. 5 p.c. ...	60—70	...
512,825	July 8	5	5	Do. 5 p.c. Perp. Pref. ...	88—93	...
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	65—70	-6
250,000	,,	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	80—85	...
888,587	June 10	5	5	Do. 5 p.c. Perp. Deb. ...	90—95	...
750,541	Aug 9	5½	5	Southampton Ord.	58—63	...
350,000	Feb. 12	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Aug. 5	5	5	Tottenham & District Ord. ...	68—78	...
338,555	,,	5	5	Do. 5 p.c. Pref.	93—98	...
453,380	June 10	4	4	Do. 4 p.c. Perp. Pref. ...	78—83	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	12/—14/-	...
1,085,952	May 13	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/-	...
745,263	June 17	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/6—14/6	...
1,200,000	Sept. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	82—87	...
380,606	Aug. 5	7	6¾	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	July 8	3½	4	Wandsworth Consolidated ...	62—72	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—70	...
1,343,964	June 17	5	5	Do. 5 p.c. Deb.	90—95	...
383,745	,,	4	4	Do. 4 p.c. Deb.	80—85	...
558,342	July 15	6	5	Watford & St. Albans Ord. ...	88—93	...
300,000	June 10	3½	3½	Do. 3½ p.c. Red. Deb. ...	85—90	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Oct. 18.	Rise or Fall on Week.
351,685	June 17	5	5	Brighton, &c., 5 p.c. Perp. Deb.	90—95	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942...	96—101	...
415,250	,, 17	4	4	Bristol Gas Co., 4 p.c. New Deb.	85—90	...
140,205	July 29	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	Aug. 19	5	5	Cheltenham, 5 p.c. Cons. Ord....	88—93	...
42,500	July 1	4	4	Do. 4 p.c. Perp. Deb....	82—87	...
150,000	Aug. 12	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	70—75	...
130,000	July 1	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Aug. 19	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	90—95	-5
53,220	,, 19	6	6	Do. 6 p.c. Cum. Pref. ...	95—100	-7½
117,425	Feb. 5	8	8	East Wight, 5 p.c. Cons. Ord. ...	100—110	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c....	65—75	...
239,135	July 8	5	5	Gas Consolidation 'A' Ord. (£1)	13/6—15/6	...
156,600	Aug. 19	5	5	Hampton C't, 5 p.c. Cons. Ord.	68—73	...
18,000	June 10	7	7	Malta & Med'n., 7 p.c. Ist Pref.	60—65	...
10,845	,, 10	7½	7½	Do. 7½ p.c. 2nd Pref.	60—65	...
50,000	Aug. 19	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	63—73	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref....	85—90	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	87—92	...
76,501	July 1	4	4	Reading, 4 p.c. Perp. Deb. ...	75—80	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	June 10	5	5	Slough, 5 p.c. Perp. Deb. ...	90—95	...
211,740	,, 17	5	5	Southampton, 5 p.c. Red. Deb.	96—101	...
363,575	July 1	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	95—100	...
202,019	Oct. 14	6⅔	6⅔	Tunbridge Wells, 4 p.c. Scale ...	70—80*	...
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	90—95	...

PROVINCIAL EXCHANGES

47,756	July 26	6	5	Bath Cons.	98—103	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	July 15	5	5	Bristol, 5 p.c. max. ...	87—90	+1
120,420	June 17	4	4	Do. 1st 4 p.c. Deb.	94—96	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb.	92—95	...
328,790	,,	5	5	Do. 5 p.c. Deb.	108—111	...
157,150	Aug. 5	6½	5	Chester 5 p.c. Ord.	98—101	...
92,500	June 17	4	4	Do. 4 p.c. Pref.	80—85	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	80—85	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	94—98	...
542,270	Aug. 12	9	6	Derby Cons.	100—105	...
55,000	June 10	4	4	Do. 4 p.c. Deb.	96—102	...
10,000	Aug. 19	10	10	Great Grimsby 'A' Ord. ...	170—180	...
6,500	,,	10	10	Do. 'B' Ord. ...	170—180	...
79,000	,,	10	10	Do. 'C' Ord. ...	160—170	...
732,000	Aug. 26	4	4	Hartlepool G. & W. Cn. & New	63—68	...
2,167,410	Aug. 19	6	6	Liverpool 5 p.c. Ord.	96—98	...
245,500	June 17	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	July 15	4	4	Do. 4 p.c. Deb.	99—101	...
20,000	June 24	5	5	Long Eaton 5 p.c. Pref.... ...	9—11	...
80,000	June 24	5	5	Do. 5 p.c. Deb.... ...	100—105	...
2,430,267	July 29	5 7/10	5	Newcastle and Gateshead Con.	15/9—16/9a	--/3
682,856	,,	4	4	Do. 4 p.c. Pref.... ...	74—76	...
776,706	Dec. 27	3½	3½	Do. 3½ p.c. Deb.... ...	80—85	...
277,285	April 24	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	July 26	5	5	Newport (Mon.) Ord.	89—93	...
13,200	Sept. 16	8⅜	7	Pontyp'l Gas & W. 10 p.c. 'A'	11¼—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Aug. 5	8	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—123	...
1,806,339	Aug. 26	6½	6½	Sheffield Cons.	118—120	...
95,000	July 8	4	4	Do. 4 p.c. Deb.	97— 99	...
332,351	Feb. 5	6	6	Sunderland 6 p.c. max. ...	107—112	...
140,778	Aug. 12	5	5	Weston-super-Mare Cons. ...	80—85	...
64,338	June 24	4	4	Do. 4 p.c. Deb.	75—85	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	137—145	...

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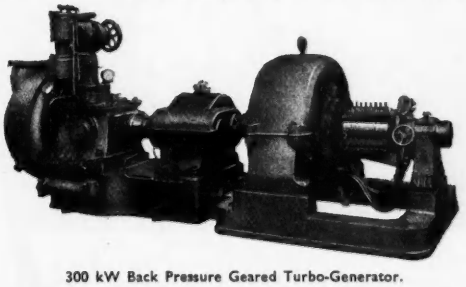

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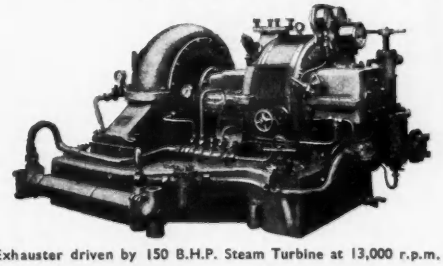

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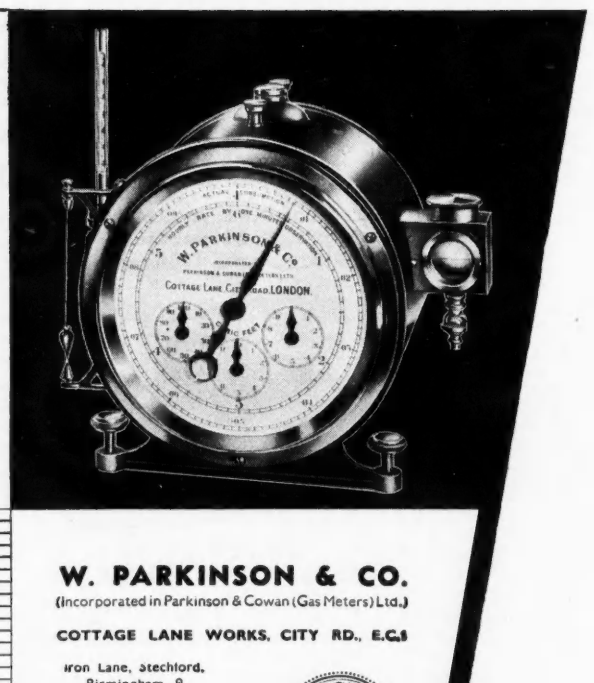

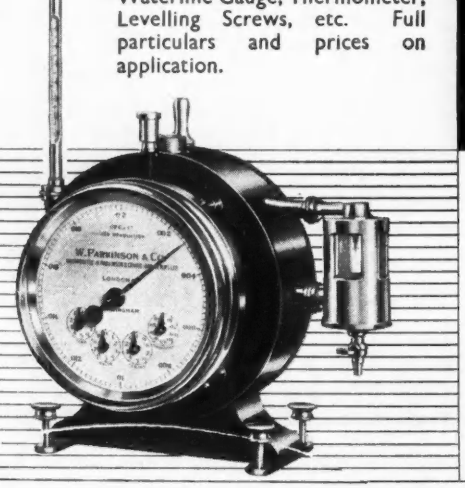

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